Pertussis Disease Plan

Disease and Epidemiology

Clinical Description:

- Initial presentation with mild upper respiratory tract symptoms (catarrhal stage).
- Progresses to cough and then usually to paroxysms of cough (paroxysmal stage), often with a characteristic inspiratory whoop and commonly followed by vomiting.
- Fever is absent or minimal.
- Symptoms fade gradually over weeks to months (convalescent stage), typically 6-10 weeks.

In children under 6 months: the most common symptom in infants is apnea, and the whoop is often absent. In older children and adults: the presentation may lack the whoop; the most common symptom for these age groups is a prolonged cough.

Causative agent:

Bordetella pertussis is a fastidious, gram-negative bacterium. Other infectious agents may cause an illness with similar symptoms. These agents are: *Bordetella parapertussis, Chlamydia trachomatis, Chlamydia pneumoniae, Bordetella bronchiseptica* and certain adenoviruses.

Differential diagnosis:

Typically, viruses cause upper respiratory infections/bronchitis. The frequency of pertussis as a cause of upper respiratory infection with prolonged cough varies, but can range from 5-20%. Other bacterial pathogens causing upper respiratory illnesses include *Bordetella parapertussis, Mycoplasma pneumoniae*, and *Chlamydia pneumoniae*.

Laboratory identification:

In children, the inspiratory "whoop" of pertussis is characteristic of this disease.

- Children with the classical presentation of paroxysmal cough, inspiratory whoop, and subsequent vomiting can be considered to have pertussis and treated.
- Adults and children with atypical presentations should have the diagnosis of pertussis verified through laboratory testing in order to reduce the amount of antibiotics incorrectly prescribed for viral conditions.
- **PCR** - Currently, this test is the best option in most clinical circumstances. This test provides acceptable sensitivity in children and adults, has a relatively short turnaround time, and is available at most commercial reference laboratories.
    - Collect a nasopharyngeal sample on Dacron NP swab. Transport as per testing laboratory.
    - **Note: NP swabs have thin wire shafts and are flexible. You cannot collect an NP specimen with a throat swab. Throat swabs and cough plates are not acceptable specimens.**
- **Culture –** The sensitivity of this test varies widely. However, the length of time to obtain results makes it unacceptable for determining patient therapy. Generally this test could be used when:

- Testing children (sensitivity in adult patients is unacceptable)
- Using an on-site laboratory (transport decreases yield)
- Patients have not started taking antibiotics
- Patients are within two weeks of symptom onset
- Determining possible antibiotic resistance Collect a nasopharyngeal aspirate or nasopharyngeal swab (on Dacron or rayon NP swab), plate directly to culture media.
- **Note: NP swabs have thin wire shafts and are flexible. You cannot collect an NP specimen with a throat swab. Throat swabs and cough plates are not acceptable specimens.**

- **DFA** – While the speed of this test is appealing to determine antibiotic therapy, the sensitivity and specificity of this test are unacceptable.
- **Serology** – This requires paired acute and convalescent sera and therefore it is not recommended for diagnosis due to the wait for convalescent sera. The use of a single serum specimen for diagnostic purposes is not well standardized outside of a research setting.

Treatment:

The extent to which antibiotics reduce the duration and severity of illness is still debated, but antibiotics have been shown to eradicate carriage of the Bordatella pertussis. It is widely believed that antibiotics started early in the course of illness are more likely to reduce the illness duration and severity than antibiotics started late in the course of illness.

Public health recommends that antibiotic treatment for pertussis be provided under the following guidelines:

Treat regardless of the duration of illness:

- Infants under the age of 1
- Pregnant women
- Patients with ongoing, close contact with infants under the age of 1 or pregnant women (e.g., parents and caregivers of infants, daycare workers, pediatricians)

For all others, limit antibiotic treatment to those who are within three weeks of the onset of their illness.

Therapy recommended by the CDC in the 2005 revision of Guidelines for Control of Pertussis Outbreaks:

Drug	Infants <1 month	Children 1- 6 months	Children > 6 months	Adults	Duration
Azithromycin	10 mg/kg/day in a single daily dose[1,7]	Not licensed, but may be used. 10 mg/kg/day in a single daily dose[1]	10 mg/kg in a single dose (day one); then 5 mg/kg per day in a single dose.	500 mg in a single dose, day one; then 250 mg in a	5 days

			(days 2-5) (maximum 500 mg/day)	single dose, days 2-5[3]	
Erythromycin[8]	2nd line choice. See children > 6 months for dosing[1]	See children > 6 months for dosing[1]	40-50 mg/kg per day, in 4 divided doses (maximum 2 g/day)	250 - 500 mg, 4 times per day[2]	14 days
Clarithromycin	Not recommended.	Not licensed, but may be used. See children > 6 months for dosing.[1]	15 mg/kg per day, in 2 divided doses (maximum 500 mg/dose)	500 mg, twice daily[4]	7 days
TMP/SMZ			8 mg/kg per day (TMP) 40 mg/kg per day (SMZ), in 2 divided doses	1 DS tablet, twice daily[6]	14 days

[1]An association between orally administered erythromycin and infantile hypertrophic pyloric stenosis (IHPS) in neonates has been reported.
[2]Erythromycin is classified as an FDA Pregnancy Category B drug.
[3]Azithromycin is classified as an FDA Pregnancy Category B drug.
[4]Clarithromycin is classified as an FDA Pregnancy Category C drug.
[5]TMP/SMZ may be used as an alternate agent in patients who are allergic to or cannot tolerate macrolides.
[6]TMP/SMZ is classified as an FDA Pregnancy Category C drug. It should not be given to pregnant women, nursing mothers, premature neonates, or infants <2 months of age.
7 Treatment of pertussis is not an FDA approved use of azithromycin, but CDC has recommended it as first line treatment. Data on use of azithromycin in infants, 6months of age is limited, but CDC recommends it as preferred drug for pertussis in infants under 1 month of age. In infants 1-5 monthes, erythromycin and azithromycin were equally recommended.
8Whenever available the estolate preparation of erythromycin should be used.

Resistance to macrolides is rare. Penicillin-class drugs and first/second generation cephalosporins are not effective. Susceptibility testing is generally not done.

Case fatality:

In vaccinated populations, the fatality rate is very low (approximately 1% in infants younger than 2 months of age and less than 0.5% in infants 2 – 11 months of age). Fatalities typically are only seen in children under the age of 6 months. In unvaccinated populations, morbidity can be significant, but mortality is rare with appropriate medical care. However, because most of reported pertussis cases in infants are hospitalized, complication rates are likely to be representative of more severe illness.

Reservoir:

Humans are the only known hosts of *B. pertussis.*

Transmission:
Pertussis is transmitted via close contact with aerosolized droplets of respiratory secretions from infected individuals. Transmission can also sometimes occur through contact with infected fomites. This disease is not thought to have airborne transmission.

Pertussis is highly communicable, with secondary attack rates in susceptible household contacts as high as 90%. The majority of infectious patients are symptomatic; asymptomatic transmission is rare.

In hospital/LTC facilities, use droplet precautions.

Incubation period:
6 – 21 days, usually 7 – 10 days.

Period of communicability:
Patients are most contagious during the catarrhal stage and the first two weeks after cough onset (approximately three weeks from the initial onset of symptoms). Patients are considered non-infectious following 5 days of antibiotic therapy.

Susceptibility:
Susceptibility is universal in unimmunized persons and since immunity wanes with time, most adolescents and adults are also susceptible. Females have higher incidence and mortality. Vaccination provides protection for several years, as does active infection, but both types of immunity wane and repeated infections are common.

Epidemiology:
Outbreaks typically occur every 3-4 years.

The highest annual incidence of pertussis occurs among unvaccinated children aged < 5 years. Secondary attack rates are approximately 80% to 90% among susceptible household contacts.

Recently, both national and Utah trends demonstrate an increasing age in pertussis cases. It is unclear whether this is a real trend, or if it is due to increased recognition, diagnosis, and reporting of pertussis in adolescents and adults. Recently, nearly 2/3 of the reported cases of pertussis in Utah occurred in the adolescent and adult population.

It is hypothesized that widespread use of pertussis vaccine in children may be responsible for the shift in reported cases to adolescents/adults. In vaccinated populations, fewer mothers have acquired immunity through natural infection and may be less likely to provide passive immunity to an infant through transfer of maternal antibody. This leaves children under the age of one year as a highly at-risk population.

Public Health Control Measures
Public health responsibility:

- Prevent illness in high-risk individuals through disease investigation, administration of vaccine, and antimicrobial prophylaxis.
- Promote vaccination to reduce disease burden in the community
- Provide education to the general public (regarding disease transmission) and to clinicians (regarding disease diagnosis, reporting, and prevention)
- Monitor disease trends

Prevention:

The primary method of pertussis prevention is through vaccination.

Childhood immunizations:

Children should start receiving pertussis vaccine at 2 months. The schedule for childhood vaccination is:

Dose	Age
Primary 1	2 months
Primary 2	4 months
Primary 3	6 months
First Booster	15-18 months
Second Booster*	4-6 years
Tdap Booster	11-12 years

* The second booster is not necessary before entering kindergarten or elementary school if fourth dose is administered on or after the fourth birthday.

Adolescents ages 13-18 who have not received a booster of Td should receive a dose of Tdap as their catch-up dose rather than Td. Adolescents who have already received a booster with Td at age 11-12 are encouraged to also receive a dose of Tdap also. The ACIP didn't define an optimal interval between Td and Tdap. A five-year interval is recommended to reduce frequency of side effects, but a shorter interval may be used when protection from pertussis is needed.

The childhood vaccine is estimated to reduce the severity of disease by 50-90%. Children who receive the full series of vaccine can still acquire pertussis, and the diagnosis of pertussis should not be excluded based upon an adequate vaccination history.

Adult immunization:

Adults19-64 years of age should receive a single dose of Tdap (Adacel™) to replace a single dose of Td for booster immunization if they received their most recent tetanus-toxoid containing vaccine ≥ years earlier.

Tdap may be given at a shorter interval than 10 years since the receipt of the last tetanus-toxoid containing vaccine to protect against pertussis. The safety of intervals as short as 2 years between administration of Td and Tdap is supported.

Adults who have never received tetanus and diphtheria toxoid-containing vaccine should receive a series of three vaccinations. The preferred schedule is a single dose of Tdap, followed by Td ≥4 weeks later, and a second dose of Td 6 to 12

months later. Tdap may substitute for Td for any one of the three doses in the series.

Adults who have or anticipate having close contact with an infant under 12 months of age (i.e. parents, healthcare providers, childcare providers) should receive a single dose of Tdap. Tdap should be given at least 1 month before beginning close contact with the infant.

Pregnancy is not a contraindication to Tdap or Td vaccination. Women who received the last tetanus-toxoid containing vaccine <10 years earlier should receive Tdap in the post-partum period. Women who received the last tetanus-toxoid containing vaccine ≥10 years earlier should receive Td during pregnancy in preference to Tdap.

Pregnant women who have not received the primary 3-dose series for tetanus should begin the series during pregnancy.

Tdap should be administered with other vaccines that are indicated during the same visit when feasible. Each vaccine should be administered using a separate syringe at different anatomic sites.

Outbreaks:

Given the increasing numbers of pertussis cases that are reported, local health departments must use their judgement on determining when it is justified to declare an outbreak. Declaration of an outbreak can be useful to elicit media coverage and support from physicians for improved interventions including case detection, reporting, and administration of prophylaxis and treatment. When an outbreak is declared, additional public health resources may need to be allocated to control the situation. Local health departments are urged to consult with the Utah Department of Health during outbreaks in order to develop situation-specific control measures and identify additional resources.

Isolation and quarantine requirements:

Hospitalized cases:

Droplet precautions.

School or Daycare:

Exclusion from School or Daycare:

- Symptomatic persons with pertussis shall be excluded from school or childcare settings until they have received five days of appropriate antibiotic therapy, or if not treated, until 21 days after onset of symptoms.
- Inadequately immunized close contacts under the age of 7 shall be excluded from schools, daycare, and public gatherings for 21 days after their last exposure or until the case and contacts have received 5 days of appropriate antibiotics.

R396-100-8. Exclusions of Students Who Are Under Exemption and Conditionally Enrolled Status.

(1) A local or state health department representative may exclude a student who has claimed an exemption or who is conditionally enrolled from school attendance if there is good cause to believe that the student has a vaccine preventable disease and:

(a) has been exposed to a vaccine-preventable disease; or

(b) will be exposed to a vaccine-preventable disease as a result of school attendance.

(2) An excluded student may not attend school until the local health officer is satisfied that a student is no longer at risk of contracting or transmitting a vaccine-preventable disease.

Workplace:

Adults with pertussis should refrain from public activities and the workplace for the first 5 days of a full course of antimicrobial treatment. Persons with pertussis who do not take antimicrobial treatment should refrain from public activities and the workplace for 21 days from onset of cough.

Outbreaks:

Additional measures to limit transmission may be appropriate in outbreak settings. Please consult with your local health department or the Office of Epidemiology, Utah Department of health, if you suspect an outbreak.

Case Investigation

Determine case status

Does the case meet the case definition for confirmed or probable? Continue investigation for all confirmed and probable cases.

- **Confirmed:**
  - An acute cough illness of any duration that is culture positive for B. pertussis, OR
  - A cough illness lasting 2 weeks with any one of the following symptoms:
    - Paroxysms of coughing,
    - Inspiratory "whoop", OR
    - Post-tussive vomiting, without other apparent cause (as reported by a healthcare professional); AND
    - Positive PCR for B. pertussis; OR
    - Direct epidemiological-link (1st generation contact) to a case confirmed by culture or PCR.

  Note: IgM serology and DFA do not constitute laboratory confirmation and are not sufficient to establish confirmed cases. However, cases that meet the case definition for probable cases will still be investigated. Serology and DFA can be useful to identify individuals who should be investigated as probable cases.
- **Probable*:***

- A cough illness lasting 2 weeks with any one of the following:
  - Paroxysms of coughing,
  - Inspiratory "whoop", OR
  - Post-tussive vomiting, without other apparent cause (as reported by a healthcare professional).

- *NOTE: Different case definitions may be appropriate for use to guide interventions during an outbreak response. Please consult with the Bureau of Epidemiology in these settings.*

Determine onset of symptoms

Based on date of onset of first symptoms of illness. In patients who experienced a catarrhal stage, the onset of those symptoms should be used as onset date.

Actions to be taken with the case patient

Treatment:

Treat regardless of the duration of illness:

- Infants under the age of 1
- Pregnant women
- Patients with ongoing, close contact with infants under the age of 1 or pregnant women (e.g., daycare workers, pediatricians)

For all others, limit antibiotic treatment to those who are within three weeks of the onset of their illness.

Note: there is little evidence that antibiotic treatment shortens the duration or reduces the severity of pertussis. Public health nurses should use their professional judgement when interpreting these guidelines.

Isolation:

Symptomatic persons with pertussis (confirmed or probable) shall be excluded from school or childcare settings until they have completed five days of appropriate antibiotic therapy, or if not treated, until 21 days after onset of symptoms.

Voluntary isolation from work and other settings where close contact may transmit the disease is desirable. Such restriction of activity would be very difficult to legally enforce if involuntary. Educate patient that isolation should occur until five days of appropriate antibiotic therapy has been completed.

Education:

Provide an educational fact sheet to the patient. If the patient works at or attends a childcare or school, work with the school administration to send notification letters to other students/parents/teachers as necessary.

Identification and definition of close contacts:

Close contacts are people who have the following contact with the case patient during the infectious period (defined as a three week period, starting from the onset date identified above).

- Household and immediate family members (those who spend many hours together or sleep under the same roof);
- Those who have direct contact with respiratory secretions;
- Healthcare workers with extensive face-to-face contact with a patient who is coughing; and
- Those who share confined space (within 6 feet) for > 1 hour during the communicable period. Such contacts may include:
    - Core groups of close friends, social contacts, boyfriends, girlfriends,
    - Students sitting within 3 feet at school,
    - Contacts at church activities and employment,
    - Participants in extracurricular activities (such as fieldtrips),
    - Children attending after-school care or a playgroup.

- If patient is a healthcare worker, notify the facility in which they work. That facility should identify and refer all symptomatic co-worker and patient contacts for medical evaluation immediately and treat if necessary.

Case contact management:

Asymptomatic contacts:

Vaccination:

For close contacts (< 7 years of age) of pertussis cases:

- Assess immunization status;
- Recommend a fourth dose be given to all children who have received their third dose of DTaP 6 months or more before the exposure;
- Recommend a booster be given to all children who have received four doses of DTaP, unless the fourth dose was given in the past 3 years.

Note: asymptomatic contacts under the age of seven that have not received at least three doses of DTaP before the exposure shall be excluded from school/child care unless they elect to receive chemoprophylaxis.

For close contacts (7-10 years of age) of pertussis cases:
Currently, there is no vaccine licensed for use in children ages 7-10.

For close contacts (10-18 years of age) of pertussis cases:

- Recommend vaccination with Tdap
- A 5-year interval between TD and Tdap is safe, but may cause a higher risk of local or systemic reactions; Tdap may be given after a shorter interval when the risk of transmission outweighs the risk of a reaction
- Adolescents with history of pertussis should still receive the vaccine
- *Note: There is only one vaccine approved for 10 year olds.*

For close contacts (>18 years of age) of pertussis cases:

- Advise people of the availability of a licensed vaccine for adults
- ACIP recommends adults receive a single dose of Tdap to replace a single dose of Td for booster immunization

- Tdap may be given at an interval shorter than 10 years since receipt of last tetanus-toxoid containing vaccine to protect against pertussis (interval as short as approximately 2 years)
- Adults who have or will have close contact with an infant <12 months of age should receive a single dose of Tdap
- Women who received the last tetanus-toxoid containing vaccine ≥10 years earlier should receive Td during pregnancy in preference to Tdap
- Women who received the last tetanus-toxoid containing vaccine <10 years earlier should receive Tdap in the post-partum period, according to the routine recommendations for vaccinating adult contacts of infants <12 months of age
- Pregnant women who have not received the primary 3-dose series for tetanus should begin the series during pregnancy

Chemoprophylaxis:

Prophylactic antibiotics may reduce secondary transmission in household and other settings. However, due to the:

- Lack of evidence supporting this conclusion,
- High number of pertussis cases occurring despite widespread antibiotic chemoprophylaxis, and
- The risk of antibiotic resistance developing due to overuse of antibiotics,

UDOH recommends focusing efforts to provide chemoprophylaxis on high-risk contacts.

High-risk contacts include:

- Infants under the age of 1,
- Pregnant women,
- Contacts who work with high-risk individuals (e.g., daycare workers, healthcare workers with direct patient contact, etc.),
- Inadequately immunized schoolchildren under the age of 7, and
- Individuals, including parents and siblings, living in the same household with other high-risk contacts.

Note: other contacts can be provided antibiotics at the discretion of the Local Health Authority.

Surveillance:

If resources permit, monitor asymptomatic contacts for the development of symptoms for 10 days following their last known exposure.

Symptomatic contacts:

- Recommend all symptomatic contacts obtain medical evaluation including confirmatory laboratory testing and antibiotic treatment if pertussis is identified.
- If symptomatic contacts refuse to obtain medical evaluation, consider providing antibiotic therapy.
- All symptomatic direct contacts of a laboratory-diagnosed case will automatically be designated a confirmed case.

All contacts:

Provide educational materials to all contacts.

Forms:

Fill out the Pertussis Disease Investigation Form and fax to UDOH.

Reporting:

Pertussis is an immediately reportable disease in Utah.

References

Control of Communicable Diseases Manual (18th Edition), David L. Heymann MD, Ed., 2004.

CDC: Guidelines for the Control of Pertussis Outbreaks (2005 revision)

Red Book: 2003 Report of the Committee on Infectious Diseases (26th Edition), Larry K. Pickering MD, Ed. 2003.

Principles and Practice of Infectious Diseases (6th Edition), Gerald L. Mandell, John E. Bennett, and Raphael Dolin Eds., 2005.

Pertussis Investigation Guidelines, State of Oregon, 2005.

CD Summary, Vol 54 (9), Oregon Department of Human Services, 2005.

Pichichero, ME, et.al., Combined Tetanus, Diphtheria, and 5-Component Pertussis Vaccine for use in Adolescents and Adults; JAMA 293 (24), 3003-3011, 2005.

Preziosi, MP, and Halloran, ME, Effects of Pertussis Vaccination on Disease: Vaccine Efficacy in Reducing Clinical Severity; Clin. Infect. Dis. 37 (6), 772-779, 2003

Poland GA. The Growing Paradigm of Preventing Disease: Vaccines To Prevent Herpes Zoster and Pertussis in Adults. Annals Int Med 2005;143:539-541.

Utah Department of Health
Office of Epidemiology

January 26, 2006